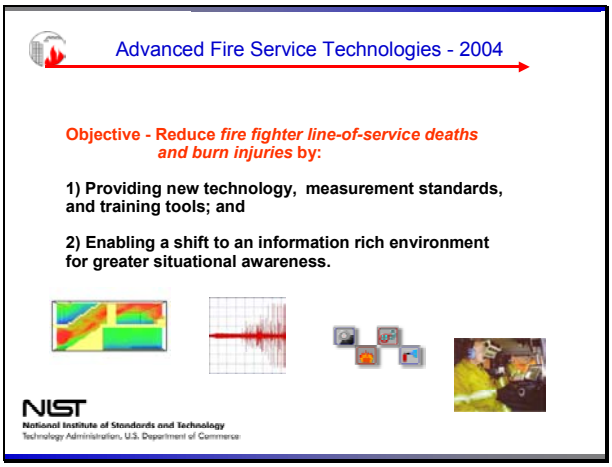
APPENDIX 3.I-

Overview of NIST Efforts to Support Fire Fighter Technologies

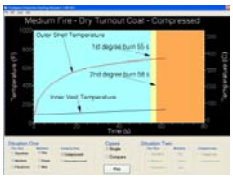
Nelson Bryner, Building and Fire Research Laboratory, NIST

The goal of the Advanced Fire Service Technologies (AFST) Program is to enable a shift to an information rich environment for safer and more effective fire service operations through new technology, measurement standards, and training tools. The research currently sponsored by AFST focuses on fire fighter protective clothing, tactical decision aids, virtual fire fighter training, and thermal imaging camera performance evaluation methods. The fire fighter protective clothing research includes development of new clothing materials and heat transfer modeling software that captures heat and moisture transport and predicts burn injuries through fire fighter protective clothing. Tactical decision aids, such as methods by which structural collapse may be predicted, and building information systems that provide data to fire fighters en route to a fire scene, are also under development. Virtual fire fighter training and visualization software that will allow a fire fighter to "walk through" a burning structure is being investigated. Methods of measuring the performance of thermal imaging cameras used by fire fighters, based on the environment in which they are used, are being studied with the intend of providing the underlying science to future performance standards.



Heat Transfer Model for Fire Fighter Protective Clothing

- Comprehensive model of Heat and Moisture Transport
- Protective Clothing Performance Simulator
- Skin Model and Predicting Burn Injury
- Effect of Moisture, Compression on Burn Injury



•Complete PPE material properties database for "used gear"

•Complete Heat Transfer Model GUI

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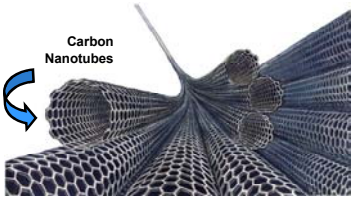
New Materials for Protective Clothing

Material Thermal Conductivity	(W/mK)
Carbon nanotube	37,000 – 2,500 (calc)
Graphite	100-200
Polymers	0.01 – 0.1



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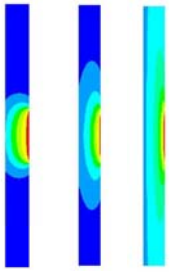
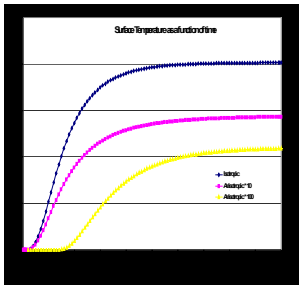
New Materials for Protective Clothing





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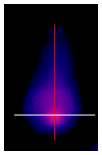
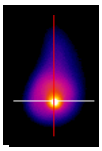
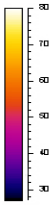
New Materials for Protective Clothing

SWNT film PAN / 10% SWNT film







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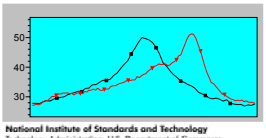

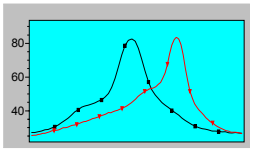

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Full Ensemble Test Apparatus/Heat Transfer Model Validation

•To identify "thermally susceptible" areas of components in the protective ensemble.

•To assess the NIST PPE Heat Transfer model

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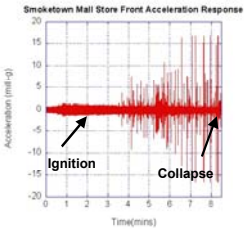
Structural Collapse Prediction

•Provide adequate warning to fire fighters of impending collapse
•Portable, quick, and easy to install

•Evaluated thermal imagers/cameras - unsuccessful
•Examined laser mappers - unsuccessful

Duron - Harvey Mudd College
•Adapt acoustic sensors for detecting leaks In hydroelectric dams

Field tested prototype
•Single family home
•Industrial warehouse
•Strip shopping mall



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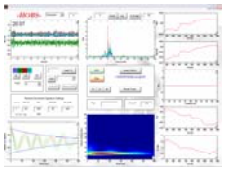
Structural Collapse Prediction

Health of Burning Structures (HOBS)

- **A real-time acquisition and analysis capability**
- **The HOBS Panel provides real-time capabilities for**
  - Multiple sensor data acquisition and storage
  - Signal processing
  - Collapse Index Analyses and Parameter adjustments
  - Fire-induced vibration and collapse index monitoring

- **HOBS Indicators include**
  - Root Mean Squared (RMS)
  - Power Spectral Density (PSD)
  - Frequency Bandwidth (FreqBand)
  - Shock Response Spectrum (SRS)
  - Random Decrement (RD)
  - Damping
  - Intensity



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Tactical Decision Aids

Provide fire fighters with tactical information before arrival

- **Information Rich Environment**
  - **Building sensors – data available at fire panel**
  - **Wireless transfer of floorplans and alarms on apparatus display**
- **Standards**
  - **What is being measured**
  - **How reported to fire panel – fire fighter**
    - NFAC Task Group: 2002 NFPA 72 Annex Graphics Annunciator Panel Standard with Icons adopted
- **Training tools**
  - **How to deploy search and suppression teams**

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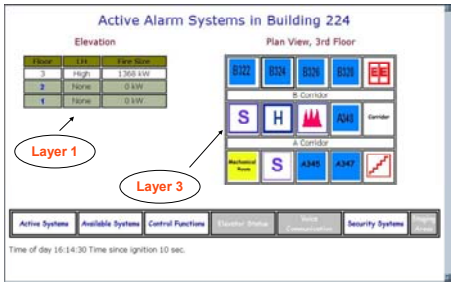
Tactical Decision Aids



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Tactical Decision Aids

Commercial Implementation (Siemens Fire Finder)

Available Systems

Active Systems

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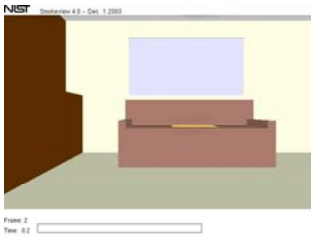
Virtual Fire Fighter Trainers

Fire Dynamic Simulator Computer Model –

Includes
- **Chemistry & Physics**
- **Material Properties**

Predict
- **Temperature**
- **Gas concentration**
- **Thermal fluxes**

Insert Fire Fighter
- **Hose Stream**
- **Ventilation**
- **IR Camera**



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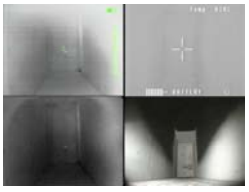
Evaluating the Performance of Thermal Imagers and Infrared Cameras

- **Fire service use thermal imagers and infrared cameras**
  - **Locate "hot spots"**
  - **Track spread of fire**
  - **Locate downed occupants and fallen fire fighters**
- **Currently there is no performance standard for thermal imagers or infrared cameras**

- **Evaluate performance of thermal imagers and infrared cameras**
  - **Lab-scale experiments**
  - **Full-scale field tests**
- **Develop standard test protocol for evaluating critical performance characteristics**



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Fire Fighting Technology Group - 2004

Project Leaders -

Dan Madrzykowski- (daniel.madrzykowski@nist.gov)
- Fire Fighter Safety Simulation
- Recreation of Fire Patterns
- Sim. Fire Burn Patterns w/Computer Models
- College Dormitory Fires
- Analysis of Indicators in Firesetting
- NFA Training Program
- Heat Transfer Model

Nelson Bryner (nelson.bryner@nist.gov)
- Equipment Standards for First Responders
- Community Scale Fire Spread
- Fire Safety and Preparedness
- Meas. and Simulation of Real Ignition
- Structural Collapse Prediction
- Urban Wildland Fire Spread

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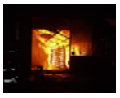
Fire Fighting Technology Group - 2004

Project Leaders -

David Stroup – (david.stroup@nist.gov)
- Structural Collapse Prediction
- Fire Performance of Building Design
- Method of Fire Resistance Determination



Nelson Bryner – (nelson.bryner@nist.gov)
- Thermal Imagers
- Thermal Imager Performance
- In-Situ Burning of Oil Spills
- Advanced PASS Devices

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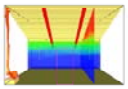
Fire Fighting Technology Group - 2004

Project Leaders -

Doug Walton – (william.walton@nist.gov)
- Positive Pressure Ventilation
- In-Situ Burning of Oil Spills
- Hose Stream Effectiveness
- Fire Reconstruction/Recreation

Randy Lawson –(james.lawson@nist.gov)
- Fire Service Technologies and Guidelines
- Firefighter Protective Clothing
- Fire Codes & Standards
- Heat Transfer Model

Bob Vettori – (robert.vettori@nist.gov)
- Sprinkler Activation under Sloped Ceiling



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Fire Fighting Technology Group - 2004

Contact Fire at NIST ?

Website - http://fire.nist.gov
http://www.bfrl.nist.gov

FireDOC - on web
Fire Research Information Service
Gaithersburg, MD
Paul Reneke 301-975-6696

Fire Data - pubs/web
Models - pubs/web
Videos - call or e-mail

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